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Laser-Induced-Breakdown-Spectroscopy as innovative and reliable diagnostic of fusionistic interest for a real-time in-situ characterization of plasma facing components

S. Almaviva[1*], L. Caneve[1], F. Colao[1], R. Fantoni[1], V. Lazic[1]

1) ENEA, Italian National Agency for New Technologies, Energy and Sustainable Economic Development

E-mail : salvatore.almaviva@enea.it

Monitoring plasma facing components (PFCs) conditions as a consequence of erosion, co-deposition of impurities from the first wall and retention of hydrogen isotopes (in particular tritium) is of great importance for continuous and fault-free operation in thermonuclear fusion research.

These needs make Laser Induced Breakdown Spectroscopy (LIBS) a valuable candidate as a real time, in-situ diagnostics tool capable to characterize PFCs of the current and next generation fusion devices, like ITER, and it is also worthwhile for quantitative analysis of surfaces, with micro-destructivity of the sample and depth profiling capabilities with sub-micrometric sensitivity.

In this contribution LIBS spectroscopy is reviewed as a valid diagnostic tool for PFCs, with special attention at the activities carried out at the ENEA Research Center in Frascati (Italy) in recent years. These activities have been devoted to LIBS characterization of samples simulating PFCs surfaces after contamination from nuclear fuel and the realization of two innovative LIBS systems: the first working out of the Frascati-Tokamak-Upgrade (FTU) device [1], characterizing its PFCs in-between plasma discharges, under vacuum conditions, the second mounted on the FTU remote handling system [2], to characterize larger areas of the vacuum vessel, in air, during shutdown periods. The obtained results will be briefly summarized in the proposed contribution.

References

[1] Maddaluno, G., Almaviva, S., Caneve, L., Colao, F., Lazic, V., Laguardia, L., Gasior, P., Kubkowska, M., and FTU team, Detection by LIBS of the deuterium retained in the FTU toroidal limiter, Nucl. Mat. En. 18, (2019), 208-211.

[2] Almaviva, S., Caneve, L., Colao, F., Lazic, V., Maddaluno, G., Mosetti, P., Reale, A., Gasior, P., Gromelski, W., Kubkowska, M., LIBS measurements inside the FTU vessel mock-up by using a robotic arm, Fus. Eng. Des., 157 (2020) 111685.

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